Course guide
295203 - ISABA - Implementation of Arduino-Based Acquisition Systems

Last modified: 04/06/2026

Unit in charge: Barcelona East School of Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.

Degree: BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject).

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: SERGI MANCHÓN SÁNCHEZ - FERNANDO LUIS VAZQUEZ LABRADOR

Others: Primer quadrimestre:
SERGI MANCHÓN SÁNCHEZ - Grup: M11
FERNANDO LUIS VAZQUEZ LABRADOR - Grup: T11

Segon quadrimestre:
SERGI MANCHÓN SÁNCHEZ - Grup: M11
FERNANDO LUIS VAZQUEZ LABRADOR - Grup: T11

PRIOR SKILLS

Basic Programming skills.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:
07 AAT N3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

TEACHING METHODOLOGY

LEARNING OBJECTIVES OF THE SUBJECT

The aim of the ISABA course is to provide future engineers with the tools needed to design and implement automatic measurement and control systems to solve problems in the field of engineering.

Thus, the learning objectives covered by the course are as follows:
• Introduce measurement and control systems using microcontrollers.
• Familiarize students with the microcontroller project development board and the development environment based on MicroPython programming.
• Understand the main programming commands, instructions, and structures used to create Python programs and develop HMI (Human-Machine Interface) applications.
• Learn the main communication protocols used in industrial computing.
• Connect key sensors, actuators, and extensions (shields) compatible with microcontrollers.
• Apply acquired knowledge to develop microcontroller-based applications that solve problems in industrial, domestic, or commercial settings.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours large group	15,0	10.00
Hours small group	45,0	30.00

Total learning time: 150 h

CONTENTS

Introduction to systems based on microcontrollers.

Description:
- Digital systems programmed by software.
- Functional blocks of microcontrollers: Memory, CPU, etc.
- Programming languages.

Full-or-part-time: 9h
Theory classes: 4h
Laboratory classes: 5h

Microcontroller Programming with Python

Description:
- Project development boards based on Python-compatible microcontrollers (e.g., ESP32, Raspberry Pi Pico, etc.).
- Expansion modules for microcontrollers (shields or breakouts).
- Sensors and other functional modules compatible with Python-based microcontrollers.
- Integrated Development Environment (IDE) for Python programming (e.g., Thonny, Mu Editor, etc.).
- Python programming language applied to embedded systems.
- Python libraries and modules for hardware control.

Full-or-part-time: 17h
Theory classes: 4h
Laboratory classes: 13h

Input and Output Ports.

Description:

- Digital inputs and outputs.
- Analog inputs.
- Analog outputs.
- PWM ports.

Full-or-part-time: 17h
Theory classes: 4h
Laboratory classes: 13h

Communications with microcontrollers.

Description:
- Serial Port communications
- Bluetooth communications.
- I2C communication protocols.
- Protocols with Ethernet, WIFI, GSP ...

Full-or-part-time: 17h
Theory classes: 3h
Laboratory classes: 14h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

BIBLIOGRAPHY

Basic:
- Fairhead, Harry; James, Mike. Programming the ESP32 in MicroPython. I/O Press, 2023. ISBN 9781871962826.
- Hassan, Sarful. ESP32 MicroPython programming: an essential guide for absolute beginners & IoT projects. 2024. ISBN 9798342430944.
- Domínguez Mínguez, Tomás. Visión artificial : aplicaciones prácticas con OpenCV - Python [on line]. Barcelona: Marcombo, 2021 [Consultation: 12/09/2025]. Available on: https://elibro.net/es/lc/upcatalunya/titulos/281479. ISBN 9788426733474.

Complementary:
- Pallás Areny, Ramón. Sensores y acondicionadores de señal. 4a ed. Barcelona [etc.]: Marcombo Boixareu, cop. 2003. ISBN 8426713440.